

REMARKS

The Examiner's attention to the present application is noted with appreciation.

35 U.S.C. § 112

In Section 3 of the Office Action of December 28, 2007, the Examiner rejected claims 1-6, 8-11, 13-19, 25, 27, 39, 42, 44, and 46-49 under 35 U.S.C. § 112 ¶ 2 as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

In Section 4 of the Office Action, the Examiner stated that the number of separate deposition steps required by claim 1 remains unclear, and that it was not clear if there is any relationship between the organic solution recited in line 13 and the step of forming the seed layer. Applicant has amended claim 1 to recite: "A deposition method comprising the steps of: providing a substrate comprising an active substrate; contacting the substrate with an organic solution comprising a desired deposition component, the desired deposition component having a more noble composition than the less noble composition of the active substrate; spontaneously displacing the active substrate with a desired deposition component; and spontaneously depositing the desired deposition component from the organic solution onto the active substrate." The scope of Claim 1 has thus been clarified and now includes the relationship between the organic solution and the steps of displacing and depositing on the active substrate, the desired deposition component in the organic solution. The step of seeding the deposition substrate with a seed composition has been deleted from Claim 1.

The Examiner also noted that there seems to be no relationship between the formation of the nickel seed layer and the gold-containing organic solution, as shown in Figs. 2a-2c. The Examiner noted that the scope of Claim 1 needed to be clarified, to show the relationship of the seed composition to the deposition component. Applicant directs the Examiner's attention to page 22 lines 9 and 10 which teaches nickel films sputtered onto silicon wafers used as a substrate. Applicant directs the Examiner's attention to page 11 lines 7-10 which teaches an active nickel substrate 20 over a copper substrate 22. The nickel is originally a substrate 20, not a seed, as taught on page 11 line 7. The nickel substrate 20 subsequently performs as a seed layer, as taught on page 11, line 11 when the gold replaces the nickel in a galvanic coating process, or cementation reaction, as described on page 14, lines 22-26, and the nickel

dissolves into the organic solution. Amended independent Claim 1 recites, in part: "spontaneously displacing the active substrate with a desired deposition component;" and teaches the relationship between the active nickel substrate and the gold-loaded organic solution. Amended Claim 11 recites: "The method of claim 1 wherein the active substrate comprises at least one material selected from the group consisting of copper, nickel, iron, aluminum, steel, zinc and silver." Amended Claim 3 recites: "The method of claim 1 wherein the deposited or displacing deposition component further comprises a seed composition comprising a material selected from the group consisting of copper, platinum, palladium, gold, zinc, iron, cadmium, silver, lead, cobalt, nickel, and mixtures thereof." Thus, Applicant teaches a substrate comprising an active nickel substrate, in contact with an organic solution loaded with gold which is complexed with an organic compound, reduced at cathodic sites on the active substrate to the metallic state (e.g. gold atoms). Page 10, lines 25-26. The gold deposited on the nickel or displacing the nickel creates a seed disposed on the active substrate that activates subsequent metal deposition or replacement. Page 12, lines 2-3. Thus, in this example, the complexed noble metal is the deposition component which when deposited is reduced to a noble metal seed component. See page 12, line 15.

In Section 5 of the Office Action, the Examiner stated that no seed layer is mentioned or illustrated in Figures 1a-1c. Amended claim 1 does not recite a seed layer. Thus, the process illustrated in Figs. 1a-1c is included in the scope of amended independent Claim 1. However, Fig. 1c shows that at a later stage, the noble metal atoms create a seed on the substrate that activates the substrate for further metal buildup. Page 12, lines 5 and 15.

In Section 6 of the Office Action, the Examiner questioned whether a seed layer was required for formation of a layer of the deposition component. Amended claim 1 recites, in part: "spontaneously displacing the active substrate with a desired deposition component; and spontaneously depositing the desired deposition component from the organic solution." Thus, atoms of the desired deposition component are deposited onto an active substrate or displace the atoms of the active substrate, atoms of which oxidize into the organic solution (page 11, line 1) by a cementation process. These metal atoms then comprise a seed, facilitating a localized electrochemical cell. (page 12, line 10)

In Section 7 of the Office Action, the Examiner questioned whether Applicant's claimed process

was an electroless plating process. Applicant directs the Examiner's attention to page 12 line 10, where Applicant teaches that "This reaction is effective as a localized electrochemical cell." Applicant also teaches that, as the organic solution of the present invention is not a good electrolytic conductor (as are the prior art aqueous solutions), the deposition occurs in a different manner than conventional electrolytic reactions. This condition imparts a high degree of polarization to the system and forces the spontaneous reactions to occur over a relatively short range because of the high solution resistivities. This is in contrast to the aqueous solutions of the prior art in utilizing electrodes where the reactions can occur over much longer ranges because of the lower solution resistivities. Thus, Applicant teaches an electrochemical process that is not an electrolytic process, because it does not require an applied electric field to proceed. Applicant teaches a galvanic coating process comprising a cementation process. Page 15, line 10.

An electroless reaction requires an ionic reducing agent in a bath. The present invention, in contrast, teaches a solid active substrate that acts as the reducing agent. This type of reaction is classically termed a cementation reaction. Most organic solutions are poor conductors and thus would not be expected to serve as solvents in electrochemical processes. However, the type of organic solution as taught by the present invention, unexpectedly allowed cementation to occur in localized areas on the active substrate.

The unexpected cementation results in a metal seed particle or film forming on the active substrate that is in contact with the organic solution. In the present invention, the seed particles are preferably very small (e.g. nanometer size), but can be of any size, depending on the metal/ion, solution, substrate, etc. The active substrate, e. g. the active metal surface, is the reducing agent in the present invention, and the metal ion, e. g. the desired deposition component, to be deposited is in the organic solution. The organic solution is a poor electrical conductor, resulting in a localized reaction, i.e. a localized electrochemical cell, on the active substrate. Dissolving occurs in one location and deposition or reduction takes place near the dissolving location; the present invention thus addresses the conductivity problem in a "poorly conducting" organic solution.

In Section 8 of the Office Action, the Examiner questioned whether the reaction was an electroless or a cementation reaction. Applicant directs the Examiner's attention to page 15, line 13 through page 16,

line 13. Applicant teaches a galvanic coating process of the present invention which is a cementation reaction where, instead of the aqueous solution of the prior art, an organic solution is utilized. As the organic solution of the present invention is not a good electrolytic conductor (as are the prior art aqueous solutions), the deposition occurs in a different manner than conventional electrolytic reactions. This condition imparts a high degree of polarization to the system and forces the spontaneous reactions to occur over a relatively short range because of the high solution resistivities. This is in contrast to the aqueous solutions of the prior art in utilizing electrodes where the reactions can occur over much longer ranges because of the lower solution resistivities. Thus, the present invention comprises a cementation process.

In Section 9 of the Office Action, the Examiner states that it remains unclear whether the materials which are included within the scope Claim 1 are more or less noble. Amended claim 1 now recites, in part: "contacting the substrate with an organic solution comprising a desired deposition component, the desired deposition component having a more noble composition than the less noble composition of the active substrate;" Thus, Claim 1 now recites an "active substrate" that is less noble than the "desired deposition component." Claim 5 recites a deposition component that "comprises a material selected from the group consisting of copper, gold, platinum, palladium, silver, lead, zinc, tin, nickel, iron, and mixtures thereof." Claim 11 recites an active substrate that: "comprises at least one material selected from the group consisting of copper, nickel, iron, aluminum, steel, zinc and silver." The website located at www.corrosionsource.com provides data for these materials. A more noble deposition component will be deposited on a less noble active substrate, relative nobility is according to placement on the galvanic series.

In Section 10 of the Office Action, the Examiner discusses "the barrier layer." Claim 1 has been amended and no longer recites "the barrier layer." In Section 11 of the Office Action, the Examiner discusses the "poorly electrically conducting" and "polarizing" organic solution recited in Claim 1. Claim 1 has been amended and no longer recites "poorly electrically conducting" or "polarizing."

In Section 12 of the Office Action, the Examiner objected to claim 8 under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant has cancelled Claim 8.

35 U.S.C. § 102(b)

In Section 13 of the Office Action, the Examiner rejected claims 1-6, 8, 9, 11, 13, 15-18, 25, 39, 42, 44, 46, 47, and 49 under 35 U.S.C. § 102(b) as being anticipated by Miura et al. (5,302,256) for the reasons of record and in view of comments in Section 187, where the Examiner noted that the sulfonic acid of Miura et al. would function as a solvent in a water-containing bath in the same manner as the organic solvent of Applicant in the presence of water. Applicant's amended Claim 1 recites, in part, a deposition method comprising: "spontaneously displacing the active substrate with a desired deposition component; and spontaneously depositing the desired deposition component from the organic solution onto the active substrate." Miura et al. does not teach spontaneous deposition and does not teach spontaneous displacement. Miura et al. teach electrolytic plating of lead/tin onto copper out of an aqueous plating bath.

Applicant also directs the Examiner's attention to page 15 lines 10 through 19, where Applicant teaches the localized deposition nature of the cementation process of the present invention. Miura et al. teaches an electrochemical reaction that occurs in a conventional aqueous solution, not a localized cementation reaction. The organic solution of the present invention is incapable of supporting the plating process taught by Miura et al. Applicant directs the Examiner's attention to Examples 1 through 7 of Miura et al. that teach plating baths of 292 g/l of non-aqueous components and 708 g/l of water in Example 1; 302 g/l of non-aqueous components and 608 g/l of water in Example 2; 296.5 g/l of non-aqueous components and 703.5 g/l of water in Example 3; 339.5 g/l of non-aqueous components and 660.5 g/l of water in Example 4; 285 g/l of non-aqueous components and 715 g/l of water in Example 5; 329 g/l of non-aqueous components and 671 g/l of water in Example 6; and 302.5 g/l of non-aqueous components and 697.5 g/l of water in Example 7. Thus Miura et al. teaches a conventional aqueous plating bath and a conventional electrochemical reaction.

Applicant's organic solution and Miura's plating bath teach different deposition mechanisms. The fact that organic solutions are poorly conducting, compared to prior art aqueous solutions (page 12, line 24), results in a localized electrochemical cell. Reduction of the metal ion in the organic solution to a seed particle on the substrate occurs over a localized range because of the poor electrical conductivity of the organic solution. Miura et al. teaches an immersion tin/lead alloy plating bath that has improved properties over prior art tin/lead alloy plating baths by adding thiocyanic acid, by accelerating the plating process, and by lowering the temperature at which the process works. Miura et al. teaches a conventional aqueous electrochemical (i.e. plating or electroplating) process using an organic solvent to deposit a metal or alloy (here, tin/lead) from a suitable electrolyte solution. Applicant therefore believes that independent Claim 1 and dependent Claims 2-6, 8, 9, 11, 13, 15-18, 25, 39, 42, 44, 46, 47, and 49 are now allowable.

35 U.S.C. § 103(a)

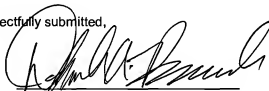
In Section 14 of the Office Action, the Examiner rejected claims 10 and 14 under 35 U.S.C. § 103(a) as being unpatentable over Miura et al. (5,302,256) in view of Zhao et al. (5,660,706). Applicant's Claim 10 recites a deposition substrate that: "comprises at least one material selected from the group consisting of Ti, Ta, W, TiN, TaN, W₂N, TiSiN, WN, WSiN and TaSiN." Applicant's Claim 14 recites a deposition substrate that: "comprises a barrier layer." The teachings of Miura et al. have been discussed above. Zhao et al. teaches an electric field initiated, i.e. electrolytic, metal deposition process. (Abstract) Applicant teaches a spontaneous gold immersion process that requires no external power source (page 2 lines 8-9, Claim 1), does not require a high pH solution, and teaches cementation onto an added solid metal. Additionally, the Examiner did not address the specific claim language of Claims 10 and 14 in the Office Action.

In Section 15 of the Office Action, the Examiner rejected claim 19 under 35 U.S.C. § 103(a) as being unpatentable over Miura et al. (5,302,256) in view of the Lowenheim text *Modern Electroplating*. The Examiner did not address the specific claim language of Claim 19 which recites a method wherein a: "non-halogenated compound comprises H₂SO₄." Additionally, the Lowenheim text *Modern Electroplating* teaches traditional aqueous solution electrochemical processes. As explained previously, Applicant teaches a cementation process occurring in an organic solution.

In Section 16 of the Office Action, the Examiner rejected claim 27 under 35 U.S.C. § 103(a) as being unpatentable over Miura et al. (5,302,256) in view of Stoffer et al. (US 2004/0249023). The Examiner did not address the specific claim language of Claim 27 which recites: "the method of claim 1 wherein the organic solution comprises a cation exchange reactant." Stoffer et al. teaches primer coatings comprising aqueous or solvent borne coating compositions containing rare earth materials. Abstract and [0015] Applicant teaches a non-aqueous, organic solution with a desired deposition composition comprising the materials listed in claim 5: a material selected from the group consisting of copper, gold, platinum, palladium, silver, lead, zinc, tin, nickel, iron, and mixtures thereof. These materials do not include rare earth materials. Thus, Claims 10, 14, 16, and 27 are believed to be allowable.

If any issues remain, or if the Examiner believes that prosecution of this application might be expedited by discussion of the issues, the Examiner is cordially invited to telephone the undersigned attorney for Applicant at the telephone number listed below. Please charge any additional fees or credit overpayment to Deposit Account No. 13-4213.

Respectfully submitted,



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